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division, perhaps) is further shown by the fact that no trace of them was seen when the bright side of the rings was presented to us at a similar low angle to that of the dark side when they were visible.

Yerkes Observatory:
1909 *May* 3.

On the Erroneous Results of a Stereoscopic Combination of Photographs of a Comet. By E. E. Barnard.

The stereoscope enables one to see objects in perspective by the combination of two photographs taken from a slightly different point of view. One way to accomplish this effect is to shift the position and direction of the camera by a proper amount between the taking of the two pictures. Essentially the same effect would be produced by the bodily displacement of the object with the camera stationary, provided all of the background were itself too distant for parallactic displacement. Both these methods would require that there were no relative change in the individual parts of the object in the interval between the two pictures. In practice, stereoscopic pictures are made by simultaneous exposures with twin lenses separated by a few inches. For celestial bodies, where our base line is too small to give any appreciable parallax, the last of the two methods is resorted to. In the case of the Moon the perspective is obtained by the aid of libration; and as the phase has to be exactly the same, a very long interval is required. In the case of a bright asteroid an interval of an hour, or of a proper motion star of several years, will produce the required effect. The short interval is also applicable to a comet, and beautiful and startling effects are produced by this means in the case of a comet with a tail. Few bright comets, however, are above the horizon long enough to permit the two photographs to be made for this purpose. On account of its high north declination, and its consequent visibility through all or nearly all the night, comet *c* 1908 (Morehouse) was specially suited for stereoscopic photographs, and the material acquired for this purpose is abundant. The combinations of proper sets of these pictures show the comet in beautiful relief suspended alone in space, as we know it is in reality, with the various parts of the tail in individual perspective. There is a wonderful effect of reality in these pictures, and the filmy, breath-like character of the comet is shown as no single picture can even hope to show it. These photographs are marvellously instructive, and one is tempted to deduce certain "facts" from the appearance which are probably entirely erroneous.

This is such a serious matter, and one so fascinatingly delusive, that I have thought it worth while to draw attention to the chances for serious errors that are inherent in the very success of the experiment in the case of a comet.

I have combined a number of photographs of the present comet

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in which the motion in an hour or so, between the exposures, permits stereoscopic effect. One of the most remarkable of these combinations is that of 1908 October 15. On this date there was a sudden twist or break in the tail, which formed irregular cloud-like masses that moved out from the comet along the general direction of the tail. In the stereoscope these two pictures produce an exquisite object suspended in front of the stars. Apparently it is easy to see which are the farther and which the nearer parts of the comet. The south end of the long irregular mass at an angle to the tail is the nearer. From this the tail has a twisted or corkscrew form, the nearer and farther convolutions of which are at once evident. The straight stem-like tail emanating from the head passes behind this mass. On each side of the head is a small stream shot out at a considerable angle to the main tail. The south one of these apparently recedes from us at a large angle to the plane of the photograph. There are other peculiarities which will be apparent to anyone viewing the picture, and which cannot be well described here.

But how much of this perspective is real? I believe that there is but little of it that can be true. In the first place, these masses were receding from the comet and changing their actual forms, and especially their position angles, so that a pseudo-stereoscopic effect would be produced, and what is really the nearer portion of the comet may appear to be a distant part. Some of the features where the details were not changing rapidly—as, for instance, the short tail from the south side of the head—would probably not be affected much by the outgoing particles, and a true stereoscopic effect would be produced. I have my doubts about much of the rest. It would be an interesting problem to differentiate the effect of the individual motion of the masses from the parallactic effect, and thus be able to tell which are the nearer and which the distant parts of the comet.

In preparing this stereogram (October 15) much trouble was experienced in making the two pictures combine. The outward motion of the masses and their angular motion separate them too much for the best result. By reducing the scale of the images considerably this difficulty was overcome and a fairly good combination obtained. This trouble did not occur with the plate of November 16, because the details were of a different nature and easily reconcilable.

All of the pictures were made with the 10-inch Bruce lens. The times and durations for these are—

		G.M.T.	Duration.
		h m	h m
1908 October 15	No. 1	12 58	1 22
	No. 2	14 31	1 30
1908 November 16	No. 1	12 14	1 5
	No. 2	13 46	1 50

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In connection with this subject I would say that I never need the stereoscope to combine these pictures. By a certain control of my eyes, any stereoscopic picture is far more beautiful without the stereoscope, and I never use the instrument. The magnification of the image is somewhat less. Indeed I have no trouble in perfectly combining thus the pictures of October 15, even when they are somewhat enlarged from the original. When one has this command over his eyes he will never again use a stereoscope.

In the stereogram of November 16 the two narrow streams emanating from the head on the left-hand (south) side are apparently ejected from the comet in a direction some 20° or 30° from the plane through the head, parallel to the plate, but away from us and beyond that plane. Those on the right or north seem to be ejected toward us, but this is rather uncertain. The entire comet has a beautiful filmy appearance, and some of the structures seem to be due to broad sheets of matter. I have compared Nos. 1 and 3 of this date, but the changes have been too large to secure good adjustment.

The comparisons of November 18 do not produce such a striking and beautiful effect, though it is very good.

While I believe that a good deal of the perspective on these stereograms is untrue, and that it does not accurately represent the actual appearance of the comet at the time, it must not be understood that I would discourage the stereographic study of comets. I believe that much can be learned of the general structure of these bodies from such a study. We must simply be guarded as to the relative perspective of the various parts of the comet at that time, as resulting from a combination of the two photographs.

Though the appearance, in a stereograph, of any one comet may be partly false, there is certainly no other method that can show us how a comet really looks in space; and for this reason, if for no other, it will, I believe, in a truthful manner, help us to understand the features of comets in general.

Yerkes Observatory, Williams Bay, Wisconsin:
1909 *May* 25.

Note by the Secretaries.

Professor Barnard has most kindly presented to the Society three stereoscopic combinations of photographs to illustrate this paper. As much of the delicacy of structure would necessarily be lost in any printed reproduction, it has been decided to make photographic copies for viewing in a stereoscope, and place them on sale to Fellows.

Prices:	Glass transparencies, .	6s. set of three.
	Prints mounted on cards,	3s. ,,

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Note on an Electric Heater for use in a plate-holder on damp nights.

(*Communicated by the Astronomer Royal.*)

This electric heater was devised by Mr. Davidson and Mr. Melotte in 1908 November for the purpose of keeping the photographic plate dry during a prolonged exposure with the 30-inch reflector.

Whilst Comet *c* 1908 was under observation it was noticed that when the photographic plate was taken from the telescope at the end of an exposure it seemed to be quite damp. The air at the time was very humid, and the gelatine of the plate (which is quite exposed at the mouth of the tube of the 30-inch reflector) had evidently absorbed a good deal of moisture from the air. The effect on the plate was an appreciable diminution in sensitiveness, shown by the fading of the star-trails as the exposure proceeded.

The electric heater was designed to remove this difficulty, as it is evident that on damp nights a limit was set to the effective exposure.

It consists of a grid of resistance wire stretched on a vulcanite frame nearly in contact with an aluminium plate, and placed in the back of the dark slide, the metal plate in contact with the sensitive plate. In the case of the plate-holder for 16 × 16 cm. plates, about 7½ yards of No. 38 "Platinoid" wire is used for the grid, giving a resistance of about 130 ohms. The current used is about 16 ampères obtained from the lighting circuit at 100 volts, a 5 c.p. lamp being introduced in series as a resistance. This amount of current is sufficient to make the plate just perceptibly warm to the touch, and experience has shown this to be enough to keep the plate dry, while at the same time the definition does not suffer from the heated air, as might happen if the plate were made unduly hot.

Royal Observatory, Greenwich:
1909 *June* 8.